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To: Mr. J. Graham
Manager
Inspection & Maintenance
Central Production Services Division

J.C. KEITH GS
INSTRUMENTATION 1990

C.B.H. Cragg

Instruments were installed in the dock and across cracks in the powerhouse structure in late 1990. Initial readings on these instruments and updated readings on existing elevation monitoring stations in the powerhouse ground floor are reported.

INTRODUCTION

The J.C. Keith GS was taken out of service and "mothballed" several years ago. Use of the dock and coal yard area has been leased to a lumber company in recent years. Use of the powerhouse may be leased to another company sometime in the future. In order to monitor the changing condition of these assets while employed by lessees, Civil Research was requested to install and read new instrumentation and to resurvey some of the existing settlement instruments. New instruments consist of survey monuments in the dock and crack gauges in the powerhouse. A description of the new instruments and a summary of the readings is presented in this report. Changing conditions will be assessed by repeating these measurements on an annual basis or other appropriate time intervals.

DOCK INSTRUMENTATION

The dock structure consists of six concrete slabs arranged in the shape of a T and supported on wooden piles. Twenty-four 3 inch diameter brass survey plugs were embedded into the dock concrete to monitor horizontal and vertical movement (see Figure 1). Horizontal movements were referenced to a twenty-fifth brass plug installed in the adjacent concrete slab support for the coal unloading conveyor. Vertical movements were referenced to

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Benchmark #4 installed in the southwest corner of the property over a decade ago/1/. Elevation and distance monitoring was done using third order survey techniques (accurate to about ± 0.001 foot). Angle measurement utilized a first order theodolite. Initial elevation readings are shown in Table I. Angle and distance readings are shown in Table II. Offset measurements from line 2-11 are shown in Table III.

During the installation and reading of these monuments, the field crew noted that the dock is not still, even when no wind or waves from ships were present. The dredge tied to the dock is causing the dock to respond horizontally E-W to wind and ship waves. Due to this movement the steel mooring lines of the barge have sawed about 0.5 inch grooves in the concrete curb of the dock.

POWERHOUSE MONITORING

Differential movements in the powerhouse were observed at an early stage in its operation. A considerable amount of instrumentation and monitoring activity ensued. Part of the current request involves monitoring the stability or movement of several structural cracks most of which have not previously been instrumented. Three dimensional crack gauges (Figure 2) were placed on six cracks in five locations in the powerhouse. Table IV describes the gauge locations and gives the initial readings.

In addition, an elevation survey was performed on existing settlement stations which had been installed in 1952, reset in 1971 and last read in 1972. This survey was performed using first order levelling equipment. Elevations relative to station 19 (column 1P) are shown in Table V. Also, shown in Table V are original 1952 "zero" elevations, altered "zero" elevations due to station alterations in 1971, elevation changes calculated from 1990 versus 1952 (1971) references and elevation changes reported in 1974/2/. The 1972 changes were originally reported in contour drawing form (see Figure 3). It will be noted from Table V that several stations show elevation changes exceeding 0.5 inch while others show little change from 1972. These elevations have been checked by the field crew, station S in particular being double checked, and appear to be in order. Further analysis is warranted but is beyond the scope of the present assignment.

SUMMARY

New instruments installed on the dock and in the powerhouse have been described. Initial readings on these instruments and a resurvey of existing settlement monuments on the powerhouse ground floor level have been documented. Follow up work on parts of the settlement survey with large changes should be undertaken.

Approved by:

J.B. Brown
Manager
Civil Research Department

Prepared by:

for C.B.H. Cragg
Senior Engineer
Soil Sciences Section

Reviewed by:

T.J. Carmichael
Supervising Engineer
Soil Sciences Section

CBHC:LM

REFERENCES

1. Dowdell, R.V. "J. Clark Keith GS - Rock Bechmark and Piezomeers Installation Report". Research Division Report No SS78-4-K, December 1978.

2. Gung, G. "Summary of Stability Studies of Ontario Hydro's Heavy Concrete Structures". Research Division Report No 74-290-H, August 1974.

TABLE I

J.C. Keith GS Dock Elevations - November 21/90

ELEVATION	ELEVATION (ft)
1	-0.77
2	0.98
3	0.99
4	0.99
5	1.06
6	1.06
7	1.00
8	1.04
9	0.94
10	0.94
11	0.91
12	1.03
13	1.05
14	1.04
15	1.06
16	1.07
17	1.06
18	1.04
19	0.975
20	0.96
21	0.93
22	-1.71
23	-1.73
24	0.995
25	1.015

All elevations relative to Benchmark 4 at 0.00

TABLE II

J.C. Keith GS Dock Angles and Distances - November 21, 1990

Angles: Angle #1 (1-11-2) 40°-58'-34"

Angle #2 (1-2-11) 40°-21'-37"

Distances:

Station to Station	Distance (feet)
2-11	584.02
3-4	5.480
5-6	4.100
7-8	4.110/4.120*
7-11	7.040/7.050*
12-21	583.34
13-14	4.095
15-16	4.092
17-18	4.100/4.110*
19-20	5.525/5.535*

*dock moving during measurements

TABLE III

J.C. Keith GS Dock Offset Survey Results

for line 2-11 stations 3, 4, 5, 6, 7, 8, 9 and 10 set on line

for line 12-21 stations 13, 14, 15, 16, 17, 18, 19 and 30 set on line

- initial offsets are 0.00

NOTE: dock sections A, B and C (see Figure) were moving horizontally E/W ~ 0.01 feet at time of alignment survey installation

TABLE IV

J.C. Keith GS - Powerhouse Crack Gauge Readings - December 11/90

GAUGE NO	LOCATION		READINGS (mm)		
	Column	Elevation	X	Y	Z
1	F18	608	26.54	27.97	24.13
2	P18	608	26.17	28.08	28.22
3	near C-15	693 (large crack)	22.59	25.41	31.19
4	near C-15	693 (small crack)	25.89	27.03	26.83
5	Q18	582.5	24.43	26.51	28.21
6	near Q18	one level below 582.5 in ceiling	25.48	26.15	30.57

TABLE V

J.C. Keith GS - Settlement Survey of Powerhouse Ground Floor

Station No		Reference Reading (inch)		1990 Readings (inch)	Change (inch)	Change (inch)
1952	1971	1952	1971		1952-1990	1952-1972
17	A	-		-1.248	-	-
18	D	0.179	0.953	1.077	+0.124	+0.090
19	B	0.000		0.000	0.000	0.000
20	C	1.153	-0.546	NA	NA	+0.050
21	G	-0.622		-0.560	+0.062	+0.045
22	H	-0.997		obstructed	NA	-0.090
23	I	0.126		0.099	-0.142	-0.035
24	J	2.154		1.650	-0.504	-0.095
25	K	0.853	0.993	0.941	-0.052	-0.030
26	M	0.092		0.018	-0.074	-0.075
27	L	0.876		0.810	-0.066	-0.055
28	N	-0.247		-0.257	-0.010	+0.005
29	O	0.662		0.680	+0.018	+0.035
30	R	-0.626	0.079	-2.496	-2.575	+0.045
31	S	0.103		0.038	-0.065	-0.040
32	U	0.037	0.490	0.480	-0.010	-0.055
33	V	-2.009	-2.019	-0.209	-0.071	-0.130
34	W	-		-0.793	-	-0.165
35	X	-0.373		-0.989	-0.616	-0.155
36	Y	1.925		1.645	-0.280	-0.250
37	AA	0.487		0.400	-0.087	-0.180
38	Z	-0.482	2.250	2.807	+0.557	-0.125
39	BB	-1.859		-1.936	-0.077	-0.090
41	CC	2.473		2.405	-0.068	-0.065
42	FF	0.068		0.021	-0.047	-0.015
43	GG	0.582	1.753	1.811	-0.058	+0.075
46	Q	-		-1.392	-	-
55	P					

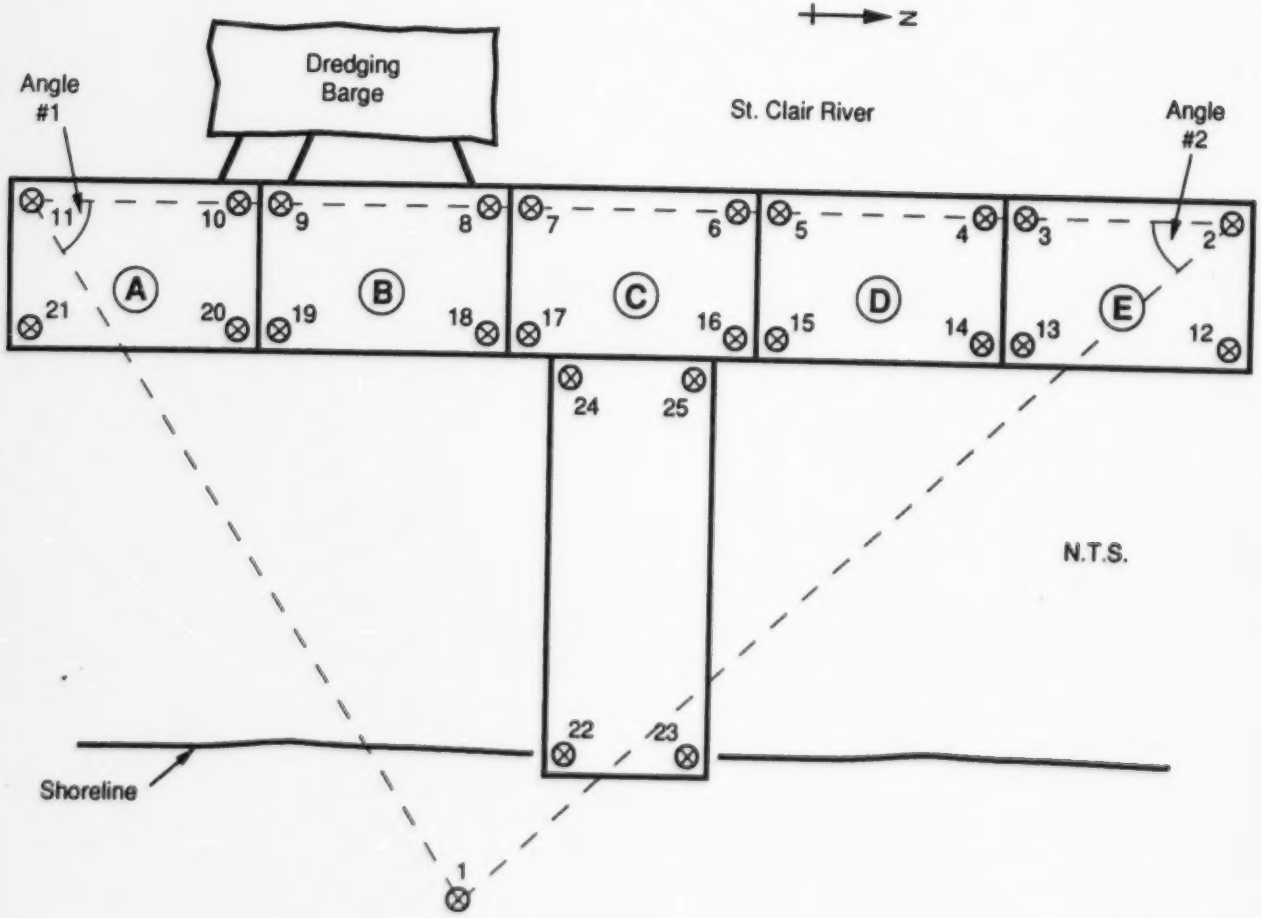


FIGURE 1

PLAN OF SURVEY STATION LOCATIONS AT J.C. KEITH G.S. DOCK

185217 RD-AF41
90-356

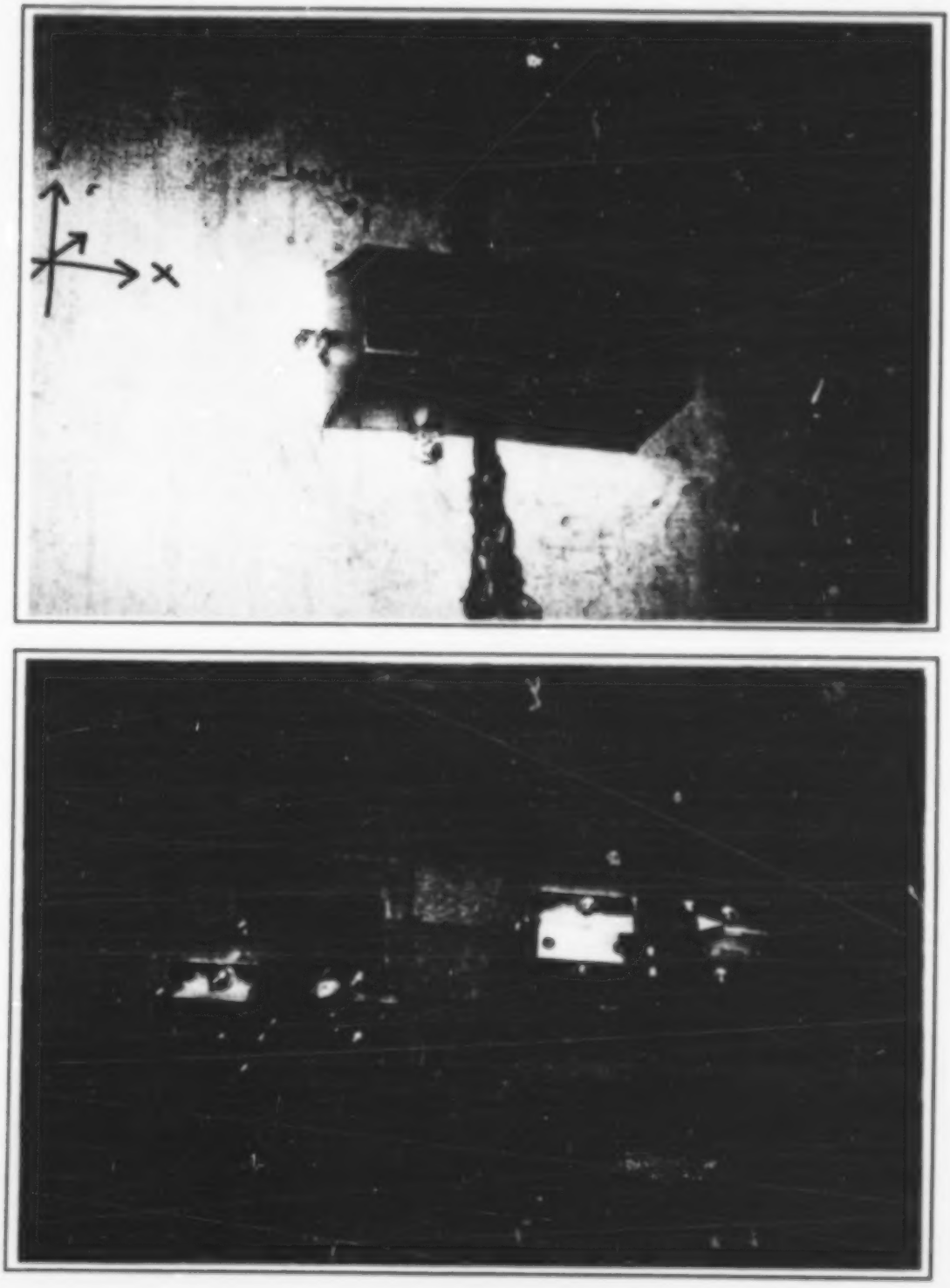
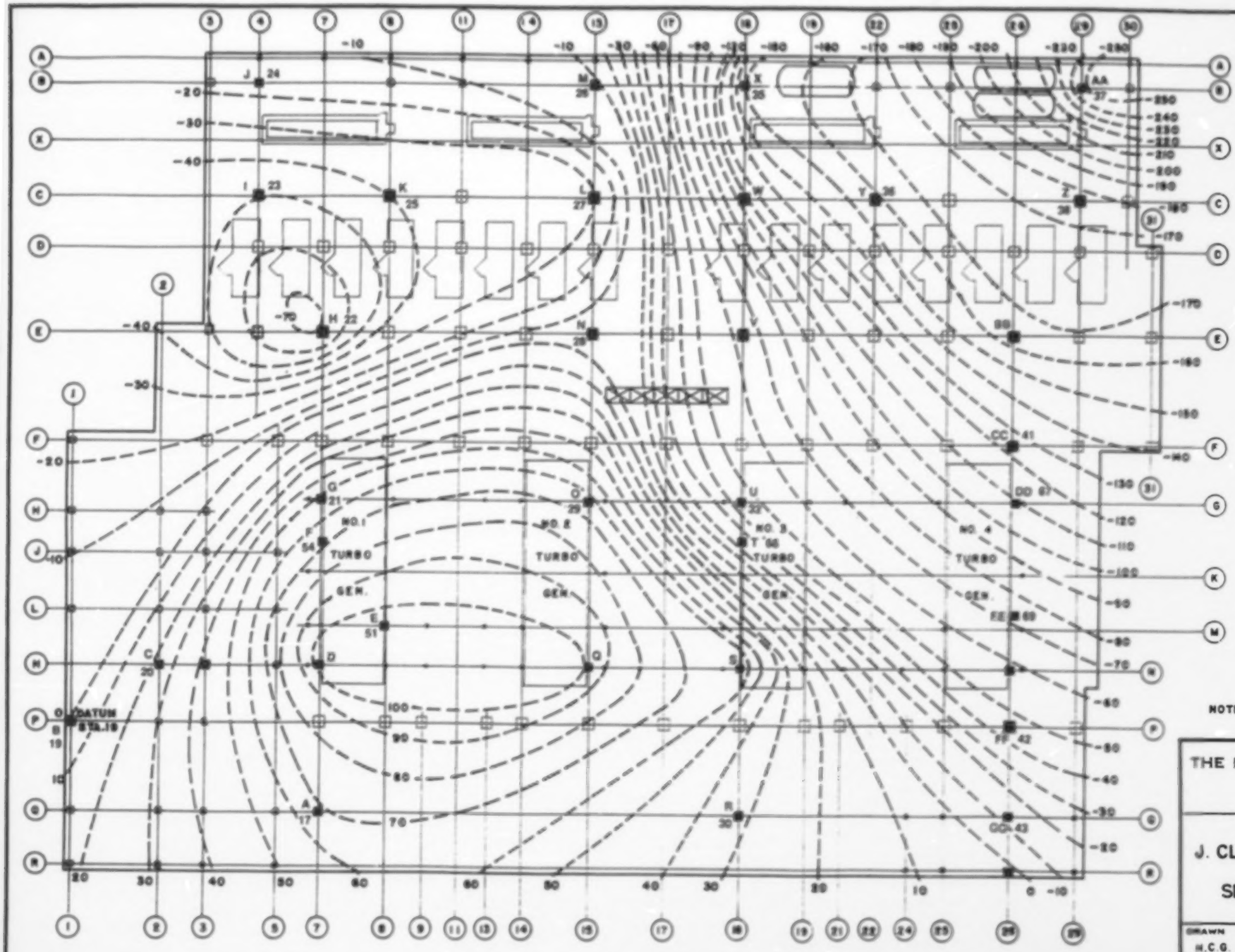


FIGURE 2

CRACK METERS INSTALLED AT J.C. KEITH G.S.
DECEMBER 1990

185216 RD-AF41



NOTE: ALL FOUR UNITS WERE SHUT DOWN DURING THE RECENT SET OF MEASUREMENTS (SEPT. 24/73)

THE HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO
RESEARCH DIVISION

J. CLARK KEITH GENERATING STATION

SETTLEMENT MEASUREMENTS

AT ELEVATION 582'–6"

DRAWN	TRACED	CHECKED	APPROVED
H.C.G.			
DATE		SCALE	
SEPT 24, 1973		——	201091 RD

NO.	DATE	REVISIONS	BY	CHK'D	APP'D